# POSSIBILITY OF A STRATEGIC ALCOHOL RESERVE AS A SUPPLEMENT TO THE STRATEGIC PETROLEUM RESERVE

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## SUMMARY


Two concerns have prompted recent interest in the federal government's establishing a strategic alcohol reserve designed along the lines of the strategic petroleum reserve (SPR):

- A desire to reduce the amount of surplus grain now held by the federal government by using such grain as an ethanol feedstock; and
- An attempt to find an alternative fuel that, like crude oil, can be stockpiled, but at less cost than the current SPR.

No specific alcohol reserve program has been proposed. Nevertheless, the Congressional Budget Office's analysis of the general economic aspects of alcohol fuels suggests several conclusions:

- Fuel-grade ethanol can be produced from excess corn stocks and stored for long periods using currently available technology. The most remunerative fuel use of this ethanol is to combine it with gasoline in a nine-to-one gasoline-to-ethanol blend to make the high-octane fuel mixture, gasohol. A commercial gasohol industry is already highly profitable, due largely to favorable federal and state tax provisions for gasohol producers.
- For the government to produce ethanol using Commodity Credit Corporation (CCC) reserves would cost more than maintaining the current price-support system. The government now acquires corn through the CCC, which obtains most of its corn as forfeited collateral used in federal price support loans, and disposes of it through commercial sales, overseas concessional sales, and donations. Producing ethanol from CCC corn stocks to make a gasohol equal in price to gasoline would cost approximately $3.60 per bushel of corn; the current price-support system now costs the government approximately $2.20 per bushel in storage and acquisition costs and lost interest charges. 1/


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1. Unless otherwise noted, all dollar values in this paper are reported as 1982 dollars.

- Using oil from the SPR to produce pure gasoline is more cost effective than producing ethanol from CCC corn stocks for use in making gasohol. The cost of producing gasohol from CCC corn-derived ethanol totals approximately 88 cents per gallon, after adjusting for energy content; the cost of simply producing pure gasoline totals approximately 82 cents per gallon.

- Withdrawing 95 million bushels of corn a year from the CCC reserve (roughly 20 percent of the reserve's current content) through an alcohol reserve program would require almost twice the current ethanol fermentation capacity, adding an estimated 722 jobs to the economy. However, the cost to the government of selling CCC grain to ethanol producers, as opposed to disposing of it through the current system, would equal $265,000 per job per year. This cost is substantially higher than past federal jobs or public works programs, which typically have run between $11,000 and $52,000 per job per year.

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This study was undertaken at the request of Representative Philip Sharp, Chairman of the Subcommittee on Fossil and Synthetic Fuels, House Committee on Energy and Commerce. It was prepared by John Thomasian of CBO's Division of Natural Resources and Commerce, under the direction of David Bodde.

# A STRATEGIC ALCOHOL RESERVE: ANALYSIS OF POTENTIAL COSTS AND ECONOMIC EFFECTS

A strategic alcohol reserve has been proposed to supplement the strategic petroleum reserve (SPR) established in 1975. This short study examines the costs and economic effects of such a reserve. It includes a brief background on the motivation behind establishing an alcohol reserve and examines the current market for gasohol, a fuel made of gasoline (90 percent) blended with ethanol (10 percent). It then compares the estimated costs of producing gasoline from the SPR against those of making ethanol from surplus corn and blending it with refined gasoline to produce gasohol.

The motive for considering a strategic alcohol (ethanol) reserve is threefold. First, it would complement the SPR. Second, such an alcohol reserve could reduce the amount of corn now held in government storage, increase grain prices, and lower the government's price support costs. Third, it could create jobs and thereby assist local economies.

## BACKGROUND

A strategic alcohol reserve would further two goals simultaneously:

- Reduce the current oversupply of corn reserves, and
- Supplement the emergency fuel value of the SPR.

The government now operates programs for storing surplus corn and for storing oil for strategic purposes. However, no federal program has yet been advanced for producing and storing ethanol, a corn product, as a strategic stockpile.

### The Strategic Petroleum Reserve

Authorized by the Energy Policy and Conservation Act of 1975, the SPR was designed to mitigate the adverse consequences of a disruption in the supply of imported oil by providing a standby source of oil. The reserve is stored in Louisiana and Texas salt domes that have been mined, leaving caverns that can hold oil.

The SPR is not full. Though its capacity can be substantially increased, the reserve now holds barely 300 million barrels of crude oil, less than half the Reagan Administration's goal of 750 million barrels by calendar year 1988. 1/ The Administration plans to place in the SPR another 80 million barrels in 1983 and 53 million barrels in 1984, spending between $2 billion and $3 billion each year. In 1982, the average cost of acquiring crude oil at the Gulf Coast storage sites was $33.75 per barrel, not including the one-time storage costs, which run roughly around $4 per barrel.

To reduce the cost of the SPR, concern has been directed at alternative fuels that can serve as a supplement or substitute. Ethanol, which could serve as a supplement, has received serious consideration from time to time.

## Programs for Storing Surplus Corn

In the last 15 years, the amount of corn produced on U.S. farms has risen sharply, while demand for corn has risen only slightly. In 1982, farmers produced 8.4 billion bushels of corn--roughly twice the amount produced in 1967; during the same period, domestic consumption increased only 15 percent to 20 percent. Although domestic producers now export 25 percent to 35 percent of their annual harvest, the growth of exports has not kept pace with increased production. As a result, corn prices have declined from their 1974 high of about $5 per bushel to the nationwide January 1983 average price of $2.32 per bushel. Recent corn prices have been quite volatile: from April 1981 to October 1982, corn prices fell from $3.30 to $1.90 per bushel.

Since the early 1930s, the Congress has established a number of programs intended to soften the impact of economic forces on farmers. These efforts are commonly and interchangeably referred to as agricultural price support programs, commodity programs, or farm programs. Until the early 1960s, federal intervention was generally directed at stabilizing farm incomes by means of price supports and controls over production and marketing. One effect of price supports has been to increase farm output beyond the requirements of the market. As a result, the Commodity Credit Corporation (CCC)--a government-owned corporation directed under the auspices of the U.S. Department of Agriculture--acquired large stocks of many commodities in an effort to support market prices.

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1. Unless otherwise specified, all dates are expressed in fiscal years.

The CCC acquires corn through several mechanisms and disposes of it through commercial sales, overseas concessional sales, and donations. Most of the corn comes to the CCC as forfeited collateral used in federal price support loans. Two such loan programs are now in place: the nonrecourse loan program and the farmer-owned grain reserve. Under the nonrecourse loan program, farmers can receive short-term loans, usually lasting nine to ten months, for their corn. At the end of the loan period, they can either repay the loans plus interest and sell the corn, or they can forfeit the corn as full repayment of the loan. Alternately, farmers may enter corn into the farmer-owned reserve for a three-year period and receive a price-support loan plus annual storage payments. Under this latter program, farmers may not repay loans early and remove their corn unless prices reach a specified level. At the end of the three-year period, farmers must repay the loans or forfeit the corn as under the nonrecourse program.

In 1983, the federal government will acquire roughly 175 million bushels of corn from the last two years' crops. This grain will increase the inventory of CCC-owned corn to 475 million bushels, costing the government about $270 million in storage, interest, and handling in 1983. At the end of the fiscal year, the total government investment in CCC-owned corn will represent approximately $1.1 billion. The government will also spend an additional $600 million in 1983 for storage payments to farmers in the farmer-owned reserve program, which is projected to carry about $6.7 billion in outstanding loans in fiscal year 1983.

## Production of Ethanol from Corn Stocks

Corn can be used to produce fuel-grade ethanol. The conversion process consists of four basic steps. First, the corn is treated to produce a sugar solution. The sugar is then converted into ethanol and carbon dioxide by yeast or bacteria in the fermentation process. The ethanol is removed by a distillation process that yields a solution of ethanol and water. In the final step, the water is removed to leave dry ethanol.

The material remaining in the water solution after the ethanol is distilled away, called "stillage," contains some dead yeast or bacteria and the material in the corn feedstock that was not starch or sugar. Corn feedstocks, for example, produce a high protein stillage (called "distillers' " grain), which can be used as a marketable animal feed.

## Current Use and Production of Gasohol

The most remunerative use for fuel-grade ethanol is to blend it with gasoline to produce the high-octane lead-free fuel-grade gasohol. In 1979, the Congress encouraged consumption of gasohol by exempting it from federal gasoline taxes and granting tax incentives for capital investment in fermentation plants. These favorable tax treatments were intended to reduce dependence on oil imports, increase domestic economic activity, and support corn prices. Approximately 32 states now exempt gasohol from all or part of state taxes, thus leaving subsidies ranging from 1 cent to 10 cents per gallon. Overall, combined federal and state tax benefits on gasohol are now between 4 cents and 14 cents per gallon, or from $0.40 to $1.40 per gallon of ethanol. 2/

Gasohol yields less energy per gallon than gasoline, but it has better combustion characteristics as measured by its higher octane content (that is, it causes less engine knocking). In most markets, it sells for two to three cents per gallon more than regular unleaded gasoline. Consumption of gasohol in 1982 was about 2.0 billion gallons--equivalent to roughly 2 percent of all gasoline sold in 1982 (see Table 1). Its consumption is increasing in the Midwest and California in particular.

The growing market for gasohol has prompted a large increase in ethanol fermentation capacity. Effective production capacity has almost doubled in the last 15 months, from 270 million gallons per year to 515 million gallons. This increase is a direct result of the tax incentives. Approximately 60 percent to 70 percent of available capacity is now being used; this use rate is expected to rise to about 85 percent by this year's end. If current policies continue, new additions are expected roughly to compensate for market growth over the next few years and will probably maintain capacity utilization rates above 80 percent as long as tax incentives continue.

## POSSIBLE MECHANISMS FOR ESTABLISHING A STRATEGIC ALCOHOL RESERVE

The mechanisms for implementing a strategic alcohol reserve program would be straightforward. Fuel-grade ethanol would be made from CCC

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2. Gasohol was exempted from the entire old 4-cent-per-gallon federal tax. When the new general gasoline tax increases to 9 cents, gasohol will be exempt from 5 cents per gallon.

TABLE 1. BACKGROUND DATA FOR 1981 AND 1982

| | 1981 | 1982 | Percent Change |
|---|---|---|---|
| Total Consumption of Gasohol (Millions of gallons) | 829 | 2,026 | 144 |
| Ethanol Used in Gasohol (Millions of gallons) | 70-85 | 175-205 | 145 |
| Fermentation Ethanol Used in Other Markets (Millions of gallons) | 5-15 | 5-15 | 0 |
| Average Price of Fermentation Ethanol (Dollars per gallon) | 1.70 | 1.65 | -3 |

SOURCE: Congressional Budget Office, from data provided by Information Resources, Inc.

corn stocks, and subsequently stored in special aboveground steel tanks. Ultimately, the ethanol reserve would reach about 1 billion gallons, about 10 percent of current SPR holdings. Should another oil disruption occur, ethanol from the reserve could be blended with gasoline produced from oil held in the SPR to form marketable gasohol. This mechanism would extend the petroleum reserve by requiring roughly 10 percent less oil to be refined per gallon of motor fuel (gasohol).

## THE ECONOMICS OF A STRATEGIC ALCOHOL RESERVE

Three elements are central to understanding the economics of an alcohol fuel reserve: direct cost comparisons between gasohol and gasoline; the probable effects on grain reserves and price support costs; and the effects on jobs.

### Comparison of Gasohol and Gasoline Production Costs

Under what conditions would a strategic alcohol reserve be cost effective? To answer this question, the costs of gasoline produced from the SPR

must be compared against the costs of gasohol made from surplus grain mixed with SPR gasoline. The CBO prepared such a comparison, using data from a recent Department of Energy (DOE) study on a strategic alcohol reserve and other sources (see Appendix A).

Two different oil price assumptions and two different corn price assumptions were used in the analysis, which is displayed in Table 2. Oil prices range from a low of $28.00 per delivered barrel, a price that can be obtained in today's spot market, to a high of $34.00 per delivered barrel, roughly the historical rate paid. Corn prices range from a low of $2.47 per bushel, the current market price of corn plus transportation charges, to a high of $3.46 per bushel, which would allow full-cost recovery of the acquisition and storage of surplus corn by the CCC. Production costs from both new and existing ethanol production plants are also shown. 3/

Under all assumptions, the analysis suggests that making gasoline from oil is cheaper than gasohol from the same oil and ethanol from stockpiled grain reserves. As Table 2 shows, gasoline (at a cost between 82 cents per gallon and 97 cents) is always cheaper than gasohol (at a cost between 88.2 cents per gallon and 106.1 cents) when both are made from the same-priced oil. This is chiefly because gasoline is the dominant ingredient in gasohol, and this finding holds whether or not the ethanol is made at existing or new plants and whether or not corn is sold at the market price or at a price that fully recoups the government's cost of acquiring and storing it (adding roughly 8 cents to every gallon of gasohol).

As seen in Table 2, gasohol is shown to be cheaper than gasoline only under a limited set of assumptions--specifically, that gasohol is prepared using oil that is cheaper than the oil used to refine gasoline. In this case, the SPR is presumed to have been fitted with lower priced oil and the price of oil subsequently rises, (by $6 per barrel or more). Under these assumptions, the SPR could be extended by blending its constituent gasoline with ethanol, rather than by buying more crude oil. Such a program would also obviate the need to make spot market purchases during an oil supply degradation.

Basing a strategic fuel reserve program on this approach would be difficult, however. Implementation would require purchasing SPR oil on the

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3. The costs shown in Table 2 represent estimates of production costs only. Thus, the different tax treatments between gasoline and gasohol and their effect on sales prices in the commercial marketplace are irrelevant and are not included in the table.

TABLE 2. COMPARISON OF PRODUCTION COSTS FOR GASOLINE AND GASOHOL IN 1982 (In cents per gallon)

| | Gasoline | | Existing Gasohol Plants | | New Gasohol Plants | |
|---|---|---|---|---|---|---|
| | Low Oil | High Oil | Low Oil | High Oil | Low Oil | High Oil |
| Crude Oil Cost at Gulf Cost SPR a/ | 67.0 | 81.0 | 60.0 | 73.0 | 60.0 | 73.0 |
| Corn Cost at Current Market Price Plus Transportation b/ | --- | --- | 9.3 | 9.3 | 9.3 | 9.3 |
| Ethanol Refining and Storage Cost c/ | --- | --- | 4.5 | 4.5 | 8.0 | 8.0 |
| Storage of Crude Oil in SPR | 5.0 | 5.0 | 4.5 | 4.5 | 4.5 | 4.5 |
| Transportation of Crude to Midwest | 1.0 | 2.0 | 1.0 | 2.0 | 1.0 | 2.0 |
| Gasoline Refining Cost d/ | 9.0 | 9.0 | 6.8 | 6.8 | 6.8 | 6.8 |
| Adjustment for Fuel Efficiency e/ | --- | --- | 2.1 | 2.4 | 2.2 | 2.5 |
| Cost Comparison Using Corn at Market Price | | | | | | |
| | 82.0 | 97.0 | 88.2 | 102.5 | 91.8 | 106.1 |
| Adjustment for Full-Cost Recovery by CCC f/ | --- | --- | 8.3 | 8.3 | 8.3 | 8.3 |
| Cost Comparison Using Corn at Full Recovery Price | | | | | | |
| | 82.0 | 87.0 | 96.5 | 110.8 | 100.1 | 114.4 |

SOURCE: Congressional Budget Office from various data sources. See footnotes on the next page.

spot market (almost all of it is now bought by contract) and would not likely encourage the construction of new alcohol-production capacity, since demand for the ethanol would be intermittent. Thus, the government would have to purchase ethanol from existing producers, who now can sell their product for more than $1.00 per gallon (mostly because of favorable tax treatments). The government could not purchase the alcohol at such prices and still achieve a savings over the current SPR program. Moreover, if corn prices rise above the levels used in the analysis--a possible result from the "payment in kind" program, for example--the economics would further favor storing oil.

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FOOTNOTES TABLE 2.

a/ Crude oil prices assumed are $34/barrel for the high case (approximate past average delivered cost) and $28/barrel for the low case.

b/ A delivered corn charge of $2.47 per bushel was used in the analysis. The average national market price for corn in January 1983 was $2.32 bushel and a 15-cents-per-bushel charge was added to approximate average transportation costs to the fermentation plant. Higher prices occured in central Illinois, reaching between $2.60 and $2.65 per bushel.

c/ Ethanol refining costs for existing plants only include variable costs but both fixed and variable costs of new plants are included for new capacity. All costs include credits for by-product sale at 50 percent of the corn feedstock market price. Calculations based on figures contained in U.S. Department of Energy, A Report to Congress: Strategic Alcohol Fuel Reserve.

d/ A lower-octane gasoline produced at less cost is used when making gasohol to take advantage of the octane-boosting properties of ethanol.

e/ The use of gasohol is assumed to result in a 2.4 percent drop in mileage, based on information supplied in the DOE study.

f/ If corn were sold by the CCC at a price that would recover the full costs of acquisition, storage, deterioration, and interest, it would have to charge approximately $4.51 per bushel.

## Effect on CCC Reserves and Price Support Costs

The amount of new ethanol capacity needed to reduce the current CCC grain stockpile significantly would be sizable. To withdraw 95 million bushels from the CCC each year (roughly 20 percent of its current reserves) for use as an ethanol feedstock would require approximately 361 million gallons per year of additional fermentation capacity (almost double the industry's current level). 4/ In addition, such a program would be more expensive than the current price support system for grain.

The current CCC grain reserve consists of both corn from the long-term farmer-owned reserve program and corn from the shorter-term, nonrecourse loan program. By the time the CCC corn is disposed of (a period that typically spans the duration of the loan program plus roughly two additional years of storage in CCC bins), its real price is about $4.50 per bushel, a price that reflects acquisition costs, interest default losses, and storage charges. Because the corn is sold at or below market price (approximately $2.32 per bushel), the eventual loss to the government is $2.20 per bushel of corn.

On the other hand, to produce ethanol from the same bushel of corn (for use in making gasohol at a price equivalent to that of gasoline) the corn must be sold significantly below market price (that is, between $0.83 and $1.00 per bushel). Thus, the eventual cost to the government when operating an alcohol reserve would be approximately $3.60 per bushel of corn. This loss is $1.40 per bushel more than that incurred in operating the current price-support system.

## Effect on Jobs

An increase of 361 million gallons per year in ethanol production capacity would add approximately 722 jobs to the economy. The cost to the government to produce these jobs would be quite high: each would run approximately $265,000 per year. (This figure represents the added cost to the government of selling CCC grain to a strategic reserve as opposed to selling it on the open market; the total annual cost per job for the strategic

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4. To process 95 million bushels of corn per year into 253 million gallons of ethanol would require roughly 361 million gallons per year of design capacity, since most processes do not operate at full capacity. A program of this size would fill the equivalent 10 percent of the SPR's current volume in five years.

alcohol reserve would actually be more than double this sum, if the total cost of the price-support system and eventual sale to ethanol producers were considered.) Other federal jobs and public works programs in the past have been much less expensive. For example, the Comprehensive Employment and Training Act cost approximately $11,659 per person per year, and the Local Public Works program cost roughly $52,352 per person per year.

## CONCLUSIONS

The results of this analysis indicate that a strategic alcohol reserve would not be a cost effective supplement to the SPR or an effective alternative to current price-support program for grain. Therefore, an alcohol reserve would result in very high costs for an insubstantial number of new jobs. A substantial increase in current ethanol-production capacity would be needed to reduce grain reserves significantly. This suggests that other programs--such as a payment-in-kind plan of direct federal grain transfers to corn growers to recover income lost to crops not raised--may be better suited to lowering corn price-support costs.

## APPENDIX A: THE DEPARTMENT OF ENERGY STUDY

In December 1982, a Department of Energy (DOE) report showed a negative net economic benefit from storing ethanol as a supplement to the SPR. 1/ The report concluded that the nation would be better served by storing only crude oil in the SPR, rather than augmenting the SPR with ethanol. Only if the price of crude oil increased by approximately 19 percent in real terms (from an average price of $33.75 per barrel to $40 per barrel) would an ethanol fuel reserve be practical.

The DOE study investigated the possibility of three separate programs to provide alcohol supplies: reactivating existing uneconomic facilities to produce ethanol under contract (1.3 billion gallons); purchasing ethanol from currently operating plants (0.8 billion gallons); and constructing new facilities under contract to provide ethanol directly to the reserve (0.8 billion gallons). The study results indicated that all the programs examined were technically feasible, but none would be as cost effective as the ongoing crude oil storage program. Purchasing ethanol from the open market was found to be least expensive, although it would still cost $14 to $16 more per crude oil-equivalent barrel than the current SPR program. Reactivating old ethanol producing plants would be the most expensive ($36 to $40 more per barrel than the SPR), while dedicating new plants would run $15 per barrel to $22 more than the SPR program.

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1. See Department of Energy, Strategic Alcohol Fuel Reserve (December 31, 1982).